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USATECOM PROJECT NO. 8-5-6010-01

REPORT OF TEST OF ENGINEERING TEST OF SPIKE RESISTANT INSOLE

RDT&E PROJECT NO. 1M643303D547

FINAL REPORT

Edwin W. Mangum

AUGUST 1965

U S ARMY
GENERAL EQUIPMENT TEST ACTIVITY
FORT LEE, VIRGINIA

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U.S. ARMY GENERAL EQUIPMENT TEST ACTIVITY
FORT LEE, VIRGINIA

FINAL REPORT OF ENGINEERING TEST OF SPIKE RESISTANT INSOLE

RDT&E PROJECT NO. 1M643303D547

USATECOM PROJECT NO. 8-5-6010-01

Edwin W. Mangum
Leather Products Specialist
Engineering Test Directorate

FOR INFORMATION ONLY

ACTION BY HIGHER AUTHORITY PENDING

HOWARD W. HEMBREE, Ph.D.
Technical Director

CARL E. BLEDSOE
Colonel, QMC
Commanding

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U.S. ARMY GENERAL EQUIPMENT TEST ACTIVITY
FORT LEE, VIRGINIA

USATECOM 8-5-6010-01

Final Report of
Engineering Test of
Spike Resistant Insole

Conducted at Fort Lee, Virginia

August 1965

Abstract

This engineering test of an experimental spike resistant insole was conducted by the General Equipment Test Activity which was responsible for test plan preparation, test execution, and test reporting.

The test was conducted at Fort Lee, Virginia, during the period April - June 1965. The purpose of the test was to determine the technical performance and safety characteristics of the spike resistant insole worn in the standard tropical boot when subjected to accelerated usage.

It was found that a minimum force of 265 pounds was required at point of contact to pierce the combined outsole of the tropical combat boot and the experimental insole. The insoles are unsatisfactory from a durability standpoint, being highly susceptible to deformation and cracking. The insoles produce foot discomfort due to excessive heating of the soles of the feet. The insoles are satisfactory from a safety standpoint.

It was recommended that the experimental spike resistant insole be redesigned to prevent buckling of the steel plate, thus reducing cracking of the plate and diminishing the heat transmitted to the foot produced by flexing of the plate.

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FOREWORD

The references cited in this report are:

1. Letter, AMSTE-BC, Headquarters, U.S. Army Test and Evaluation Command, Aberdeen Proving Ground, Maryland, 2 November 1964, subject: "Test Directive, USATECOM Project No. 8-5-6010-01, 8-5-6010-02, Engineering and Service Test of Spike Resistant Insole."

2. Letter, CMGRE-D, Office of The Quartermaster General, 17 October 1961, subject: "Protection Against Foot Penetration Devices."

3. Perkins, James C. Jr., Integrated Engineering/Service of Boot Combat, Tropical, DMS, With Sole Shield, Report of USATECOM Project No. 8-3-6010-01 and 8-3-6010-02, January 1964, U.S. Army Quartermaster Research and Engineering Field Evaluation Agency, Fort Lee, Virginia.

4. Plan for Engineering Test of Spike Resistant Insole, USATECOM Project No. 8-5-6010-01, U.S. Army General Equipment Test Activity, Fort Lee, Virginia, December 1964.

The authorization for this test was:

Letter, AMSTE-BC, Headquarters, U.S. Army Test and Evaluation Command, Aberdeen Proving Ground, Maryland, 2 November 1964, subject: "Test Directive, USATECOM Project No. 8-5-6010-01, 8-5-6010-02, Engineering and Service Test of Spike Resistant Insole."

DEPARTMENT OF THE ARMY
Headquarters, U.S. Army Test and Evaluation Command
Aberdeen Proving Ground, Maryland 21005

AMSTE-BC 9 Sep 1965

SUBJECT: Final Report of Engineering Test and Service Test of Spike Resistant Insole, USATECOM Project Nos. 8-5-6010-01 and 8-5-6010-02, DA Project No. 1M643303D547

TO: Commanding General, U.S. Army Materiel Command,
ATTN: AMCRD-DM, Washington, D.C. 20315
Commanding General, U.S. Army Combat Developments Command
ATTN: USACDC Liaison Officer, USATECOM,
Aberdeen Proving Ground, Maryland 21005

1. Subject reports have been approved by this headquarters. Copies are forwarded for information and retention.

2. Findings of Engineering and Service Tests:

a. Basic findings of the reports indicate that difficulties were encountered with the Spike Resistant Insole with respect to durability and with respect to compatibility, fit and comfort when worn with Boot, Combat, Tropical.

b. Measurements of puncture resistance presented in the Engineering Test Report are static measurements. As such they give the relative increase in puncture resistance of the insole-boot outsole combination over that for the boot outsole. This increase is approximately 80%. Variations in the boot-insole protection level can be expected but these variations will be due to variability of outsole thickness as reported in previous USATECOM reports on tests of Direct Molded Sole Boots. By extrapolation of the data, the protection afforded is sufficient for a 225 pound man (includes equipment), free dropping 1.5 feet directly on the spike, to be protected.

c. Of 235 pairs of insoles used in both tests, the history of 155 pairs can be used in assessing durability (110 pairs Service Test and 45 pairs Engineering Test). Cracking of the steel plate occurred in 137 of 310 insoles. Service Test results show that of 110 pairs inspected, 106 individual insoles had developed cracks up to 1 3/4" in length in the ball (96 insoles) or shank (10 insoles) area. During the first month 20% of the total pairs had developed cracks; by the end of 7 weeks 23% had cracks; and by the end of the test (or 82 days wear) 60% had developed cracks. Engineering Test results confirm a failure rate of 20% per month of use. This is a deficiency.

d. Results of fitting trials indicate that some problem exists with regard to achieving a proper fit when the Spike Resistant Insole is used with Tropical Combat Boot in lieu of the standard ventilating insole. The Tropical Boot when properly fitted with a Spike Resistant Insole generally will not provide a proper fit when used with standard ventilating insole; the same boot when properly fitted with standard ventilating insole generally will not provide a proper fit when worn with Spike Resistant Insole. In the latter instance the fit is too tight. The extent to which this is so is evident from the following Service Test data. Forty-seven pairs of Spike Resistant Insoles (43 from Group A and 4 from Group B) were withdrawn from test because test participants refused to wear the insoles due to the discomfort caused by the insoles. Group A had been provided with boots giving a proper fit with standard ventilating insoles while Group B had been provided with boots giving an optimum fit with Spike Resistant Insoles.

e. Comments from one group of 63 test participants indicate that 50% believed their feet were hotter when wearing the Spike Resistant Insole. This may be caused in part by the stiffness of the insole and by the constant rubbing of the stockinged foot against the saran.

f. Other findings having a relation to fit or stiffness of the test insole include:

(1) Twenty percent of test participants developed chafing of ball and heel areas of the foot during extended wear periods.

(2) Blisters formed on top of toes when a tight fit condition existed.

g. The Spike Resistant Insole caused no damage to the boot nor did it interfere with drainage from the boot.

h. The layered saran portion of the test insole frayed along the edges and upper layers of the saran partially stripped loose with extended wear. This is a shortcoming.

i. No safety problems to the wearer due to the cracking deficiency were encountered in the testing.

3. Conclusions:

a. The use of the Spike Resistant Insole in the Boot, Combat, Tropical provides an increase in puncture resistance of 80% over that provided by the boot alone.

b. Use of the Spike Resistant Insole with the Boot Combat Tropical generally required one half width size greater than normal for proper fit.

c. The Spike Resistant Insole lacks durability. Cracks occur in the steel plate at a rate and with a consistency indicating a high replacement requirement.

4. This command is currently conducting a test for the U.S. Army Natick Laboratories in which the test item is a spike resistant insole modified to overcome the durability deficiency. The model of insole which is the subject of these reports is the comparison control. One

SUBJECT: Final Report of Engineering Test and Service Test of Spike Resistant Insole, USATECOM Project Nos. 8-5-6010-01 and 8-5-6010-02, DA Project No. 1M643303D547

week of the test schedule has been completed. Preliminary reports indicate that cracking of both types of insoles is occurring at the same rate (20%). Progress of this test will be reported to Natick Laboratories on a weekly basis.

5. Recommendation:

a. It is recommended that the Spike Resistant Insole not be considered suitable for type classification Standard A.

b. If an urgent operational requirement exists for protection to the feet from spikes, the Spike Resistant Slip-in Insole can be considered as an interim item partially satisfying the requirement, provided.

(1) care is exercised in assuring proper compatible fit.

(2) a high replacement rate can be tolerated.

(3) for reasons of safety, wearers are cautioned to replace any insoles where complete separation of pieces of metal has occurred.

FOR THE COMMANDER:

2 incl
as (5 cys, AMCRD-DM)
(10 cys, USACDC Ln O, USATECOM)

AUSTIN TRIPLETT, JR.
Colonel GS
Dir, Inf Mat Test

SECTION 1 - GENERAL

1.1 OBJECTIVES

To determine the technical performance and safety characteristics of the spike resistant insole as indicated by the particular design, when the insoles are subjected to accelerated usage, with specific determinations as follows:

a. The puncture resistance of the test insole using laboratory techniques when all possible combinations of new and used boots and insoles are used.

b. The extent of deformation, cracking or separation of parts of the insoles.

c. The compatibility of the insoles and boots and the influence on fit, comfort and durability of all combinations of new and used boots and insoles.

d. Detrimental effects to the wearer, personal or operational, incurred from any or all combinations of new and used boots and insoles.

1.2 RESPONSIBILITIES

The General Equipment Test Activity, Fort Lee, Virginia was responsible for the preparation of the plan of test, execution of the test, and the preparation of the test report.

1.3 DESCRIPTION OF MATERIEL

The protective slip insole consists of the standard saran insole backed by a single piece of 0.011-inch thickness steel plate. The combination is cemented together and the whole assembly is preshaped to the bottom tread of the last. The weight of one pair of insoles ranges from 4 to 5 ounces, depending on the size. When worn, the insole is placed in the boot with the saran surface up, toward the bottom of the foot.

1.4 BACKGROUND

Guerrilla tactics of hostile troops include the use of sharp spikes of metal or bamboo strategically located on the ground or under the water so that they may penetrate the outsoles of conventional footwear and result in incapacitating foot injuries.

The Office of The Quartermaster General directed that efforts be made to counteract such tactics (Reference 2). As a result of this directive, a protective spike resistant insole (insert type) was developed and testing conducted by the U.S. Army Airborne, Electronics and Special Warfare Board under Project No. CE 1262. The insole was then Type Classified Limited Production and procured in accordance with Limited Production Purchase Description 39-63.

Subsequently, the U.S. Army Natick Laboratories developed a Boot, Combat, Tropical, DMS, with Sole Shield, Spike Resistant, incorporating as an integral part of the boot a sole shield consisting of a series of overlapping stainless steel strips. Tests of this boot were accomplished by the U.S. Army General Equipment Test Activity and the U.S. Army Infantry Board (Reference 3). These tests revealed shifting of the overlapping strips which rendered the sole shield ineffective as a protective device.

After a detailed review of the need for protection of the plantar surface of the foot against spike devices, USACDC reported only a limited requirement for protection for certain special warfare personnel operating in areas of actual or potential hazards. A recommendation was made that an improved slip insole be provided for foot protection on an "as required" basis.

The laminated saran and steel plate slip insole incorporated in this subject test was developed in an effort to provide such improvement in this version of foot protection.

1.5 FINDINGS

There is no appreciable difference in the puncture resistance of any combination of new and used boots and insoles. A minimum force of 265 pounds must be applied at the point of contact to pierce through any boot outsole and experimental insole combination.

The experimental spike resistant insoles are highly susceptible to deformation and cracking (Appendix II). Separation of the saran and steel components is confined primarily to minor separations at the toe and heel areas.

The experimental insole and the tropical combat boot are compatible as a unit when both items are identically sized. The use of any other combination of sizes influences fit and comfort of the various combinations of new and used boots and insoles. The influence on the durability of boots and insoles could not be determined in that no boots and insoles were wear tested except when the two items were identically sized. The use of the spike resistant insole requires a slightly wider boot size than that required for use with the standard ventilating insole.

The experimental spike resistant insole produces excessive heating of the foot sole area, especially during the initial wear (Appendix II).

No combination of new and used boots and insoles produced detrimental effects to the wearer, personal or operational, nor to the items of foot gear.

A detailed listing of deficiencies and shortcomings is included as Appendix II.

1.6 CONCLUSIONS

a. The combined outsole of the tropical combat boot and the experimental insole will resist puncture from a force of a maximum of 265 pounds of pressure at the point of contact. The combination of new and used boots and insoles has no appreciable effect on the puncture resistance of the combined items.

b. The experimental spike resistant insoles are unsatisfactory for durability and are highly susceptible to deformation and cracking. The use of various combinations of new and used boots and insoles does not appreciably affect durability of either item.

c. The experimental spike resistant insoles are compatible for use with identically sized standard tropical boots. The use of the experimental insole in the fitting of new tropical combat boots requires a slightly wider boot for the wearer when used in lieu of the standard ventilating insole.

d. The use of the experimental insole produces foot discomfort, especially in the initial stages of wear, due to excessive heating of the soles of the feet.

e. None of the combinations of new and used standard tropical combat boots and the experimental spike resistant insoles cause detrimental effects to the wearer.

f. The experimental spike resistant insoles are satisfactory from a safety standpoint for use by Army personnel.

1.7 RECOMMENDATION

It is recommended that:

The experimental spike resistant insole be redesigned to prevent buckling of the steel plate, thus reducing the cracking of the plate and diminishing the heat transmitted to the foot produced by the flexing of the plate.

SECTION 2 - DETAILS OF TEST

2.0 INTRODUCTION

This test was conducted at Fort Lee, Virginia, during the period April - June 1965, utilizing 30 military personnel as test participants wearing the experimental spike resistant insoles in standard tropical combat boots in lieu of the standard ventilating insoles. Test activities included marching over prescribed routes over various natural terrain surfaces and traversals of the U. S. Army General Equipment Test Activity's Footwear Testing and Simulated Jungle Courses.

Fifteen of the test participants wore the same experimental insoles throughout the test period, alternating wear of two pairs of tropical boots. The other 15 participants alternated wear of two pairs of experimental insoles within a single pair of tropical combat boots. Thus, various combinations of new and used insoles and boots were incorporated in the testing to determine effects of wear on individual items and combinations of items.

The test insoles were inspected daily for cracking, splitting, deformation and other evidences of failure. Each test participant was interviewed after specified intervals for subjective evaluations of the comfort, fit, and the compatibility of the boot and insole combinations and any detrimental effect resulting from the use of the various combination.

2.1 PUNCTURE RESISTANCE CHARACTERISTICS OF INSOLES AND BOOT OUTSOLES

2.1.1 OBJECTIVE

To determine through controlled laboratory testing the puncture resistance of the insoles and the boot outsoles separately and in combinations in new and used conditions.

2.1.2 METHOD

New and used insoles selected at randcm were tested to determine m ximum poundage required for puncture of the insole only. A 3/16-inch diameter spike was used on an Instron Universal Tester at a

crosshead speed of 20 inch/minute with puncture performed at 10 locations each on one new and one used insole. An additional 4 new and 4 used insoles were also tested for puncture resistance at 2 locations on each insole.

Measurements were made at 3 locations on the outsole base of 3 new and 3 used tropical combat boot outsoles to determine the poundage required to puncture the outsole and the experimental insole in combination as well as that required to puncture the outsole only.

2.1.3 RESULTS

No appreciable difference was found in the puncture resistance of the new and the used experimental insoles. Poundage required to puncture the single new insole at 10 locations ranged from 140 to 155 pounds with an average of 148 pounds; the used insole, 143 to 170 pounds with an average of 150 pounds. The measurements obtained for two locations on each of 4 additional new and 4 additional used insoles ranged from 132 to 155 pounds with an average of 143 pounds for the new insoles and from 138 to 152 pounds with an average of 146 pounds for the used insoles.

Measurements, as shown in Table I, were obtained for: 3 each of new and used outsoles without the use of the insole; 2 each of the combinations of new outsoles with new insoles and used outsole with new insoles; and 1 each of the new outsole with used insole and the used outsole with new insole. The measurements show a minimum of 265 pounds of pressure are required at the point of contact to puncture any combination of new and used boots and insoles.

2.1.4 ANALYSIS

The similarity of measurements obtained indicate little or no influence of the combination of new and used boots and insoles. Measurements were made on the base of the outsole because this is the area most liable to puncture; spikes hitting the cleats are prone to slide off and strike the base area.

TABLE I

MEASUREMENTS OF PUNCTURE RESISTANCE
OF COMBINATIONS OF NEW AND USED BOOTS
AND SPIKE RESISTANT INSOLES

OUTSOLE		POUNDS REQUIRED TO PUNCTURE			
Condition	Number	Location Puncture	Without Insole	With New Insole	With Used Insole
New	1	A	196	343	—
		B	174	338	—
		C	143	312	—
		Avg	171	331	
	2	A	183	343	—
		B	175	330	—
		C	195	343	—
		Avg	184	335	
	3	A	148	—	315
		B	165	—	333
		C	193	—	318
		Avg	169		322
Used	1	A	150	265	—
		B	123	287	—
		C	125	280	—
		Avg	133	277	
	2	A	205	320	—
		B	241	342	—
		C	255	335	—
		Avg	234	332	
	3	A	176	—	275
		B	187	—	280
		C	162	—	272
		Avg	175		276

2.2 DURABILITY OF INSOLES

2.2.1 OBJECTIVE

To determine the durability of the spike resistant insole to include the extent of deformation, cracking, splitting, creasing, and separation of the parts of the insoles.

2.2.2 METHOD

Prior to issue, each insole was carefully inspected for the presence of any visible defects in material or workmanship which might affect test results.

A total of 45 pairs of insoles were issued for test wear. Fifteen pairs were issued for continuous wear during the entire 3-cycle testing period for use in a total of 120 miles of marching over natural terrain and 900 traversals of the Footwear Testing Course. A second 15 pairs were issued for use during two cycles for a total of 80 miles and 600 traversals. The third 15 pairs were issued for one cycle consisting of 40 miles and 300 traversals. Each cycle included 8 traversals of the Simulated Jungle Course as part of the wear over natural terrain. A maximum of 10 miles or 90 traversals were accomplished daily.

Each insole was carefully inspected after each day's activities for the presence of failures.

2.2.3 RESULTS

Eight individual insoles with defects in the bonding of the saran and steel at the toe or heel were found in the inspection of the insoles prior to issue. These areas appeared to be the result of application of insufficient amounts of cement or pressure, or both, at the edge of the steel plate and reflected a lack of bonding rather than a separation or failure of the bond. These areas were 1/2" to 1" in length and extended a maximum of 1/2" inward from the periphery of the steel plate. None of these insoles was included in the sample subjected to test wear.

Deformation of the insoles occurred in a majority of the insoles during first cycle of wear, with some instances after only two days of use.

The most prevalent deformation was a buckling of the steel plate causing a crimping or wrinkling in the inner ball area with the buckling extending 1/4" to 1" inward toward the center of the insole. This buckling was observed to a very slight degree in the six pairs of insoles used in the fitting of the potential test participants. These insoles were not used in the wear portion of the test.

Cracking of the steel plate occurred in 31 of the 90 insoles in test. In 18 instances the cracking occurred during one cycle of wear, 40 miles of marching and 300 traversals of the Footwear Testing Course. The other 13 instances occurred during the second cycle, or a total of 80 miles and 600 traversals. Nineteen of the 30 insoles worn for the full test period, 120 miles and 900 traversals, incurred failures; 6 during the first cycle and 13 during the second cycle. Ten of the 30 insoles worn for two alternate cycles incurred failures; all during the first cycle. Both of these groups of 30 insoles worn for only one cycle with used boots, incurred cracking during their cycle of wear.

The cracking in each instance occurred in the inner ball area, under the base of the great toe. The cracking occurred in some instances as jagged breaks, in others as a straight line split inward from the plate edge, and in still others as curved smooth cracks. Some of the cracks began at the plate edge and others were entirely within the steel plate. Photographs of the typical cracking of the steel plate are shown in Appendix I.

Seventy-one of the 90 insoles incurred some separation of the layers of saran in the insoles, primarily in the heel and toe areas due to wearing or breaking away of the plastic bonding. Thirty-four insoles had slight separations of the saran and steel components, in most instances at both the heel and toe. In four instances, two at the toe and two at the heel, the saran and steel parted for several inches, to a point in the shank area. In all other instances, however, the separations were minor, extending inward for 3/4" or less.

2.2.4 ANALYSIS

Not applicable.

2.3 COMPATIBILITY OF INSOLES AND TROPICAL COMBAT BOOTS AND INFLUENCE ON FIT OF COMBAT BOOTS

2.3.1 OBJECTIVES

To determine the compatibility of the experimental insoles and standard tropical boots with regard to the placement of the insole within the boot and size correlations of the two items.

To determine the influence on the fit of the standard tropical boot when the experimental insoles are used in lieu of the standard ventilating insoles in various combinations of new and used boots and insoles.

2.3.2 METHODS

Various combinations of different sizes of new boots and insoles were used to determine the satisfactory combinations for proper placement of the insole within the boot.

Test participants were fitted with new boots in combination with new experimental and new standard insoles to determine the effect on the fit of the new boots as a result of the use of the experimental in lieu of the standard insole.

Combinations of new and used boots and insoles also were checked to determine the effects of the use of the items on the fit obtained in the various combinations.

2.3.3 RESULTS

The use of the same size experimental insole as the boot with which it is to be used was found to be the proper correlation of sizes between boots and insoles. The use of a greater sized insole resulted in a slight arching of the insole lengthwise from toe to heel. The use of an insole of greater width produced an arching widthwise. Optimum fit could not be obtained in either instance.

The use of the experimental insole requires an approximate 1/2-width increase in the boot size from that required for proper fit of a new tropical combat boot in combination with the standard ventilating insole.

Since boots are not produced in 1/2-width sizes, a full width increase must be used, producing a slightly loose fit. The test participants selected had foot width dimensions which fell between full width measurements, thus, they obtained a proper fit with the use of the experimental insoles and boots sized in the greater width.

The use of new or used insoles produced no noticeable effect on fit in combination with new or used boots initially fitted with the experimental insoles.

2.3.4 ANALYSIS

Not applicable.

2.4 COMFORT

2.4.1 OBJECTIVE

To determine the influence on comfort produced by the use of all combinations of new and used boots and insoles.

2.4.2 METHOD

The test participants were divided into two groups, A and B, of 15 men each. Each group wore the test insoles and tropical boots for three cycles of 40 miles of marching over natural terrain and 300 traversals of the GETA Footwear Testing Course per cycle. Each group wore new insoles and new boots during the first cycle. Group A wore the same insoles with new boots during the second cycle while Group B wore the same boots with new insoles. During the third cycle, Group A continued use of the same insoles but reverted to the use of the boots worn in the first cycle. Group B wore their same boots for a third cycle but reverted to the use of the insoles worn in the first cycle. Thus, the participants engaged in the use of both new and used insoles with new and used boots.

Each test participant was interviewed after each cycle with regard to the comfort provided by the insole and boot combination worn during the cycle.

2.4.3 RESULTS

Similarity of responses between groups was obtained after each cycle, indicating that the combination of boots and insoles did not influence the responses. A summary of the responses obtained from each group after each cycle is shown in Table II. After the first cycle wherein both groups wore the same combination, new insoles and new boots, with three exceptions the participants reported discomfort from the use of the combination. The discomfort, primarily as excessive heating or burning of the feet, occurred on the sole of the foot, in the ball area of the foot.

This discomfort decreased during the second cycle with only approximately 50 percent of the test participants reporting discomfort. After the third cycle only 3 men in Group A and 2 men in Group B stated they experienced discomfort.

2.4.4 ANALYSIS

The decrease in responses of discomfort during the second two cycles was attributable to the boots gradually becoming "broken in" and more comfortable and also to the participants becoming accustomed to the greater than normal heat in the sole area of the boots. Ambient temperatures increased generally as the test progressed from April through June. Participants stated that their feet still got hot but they did not notice it as much. They also stated that their feet got hot more frequently and to a greater extent while on marches than while walking on the Footwear Testing Course. The participants walked through the water trough section of the course on each tenth traversal, thus their feet were cooled regularly during this operation.

2.5 DETRIMENTAL EFFECTS TO WEARER AND TO FOOTGEAR

2.5.1 OBJECTIVES

To determine any detrimental effects to the wearer, personal or occupational, resulting from the use of any of the various combinations of new and used boots and insoles.

TABLE II

TEST PARTICIPANT RESPONSES REGARDING COMFORT

Question	Response	1st Cycle		2nd Cycle		3rd Cycle	
		Group and Insole and Boot Combinations Worn (N.B.-New Boots; U.B.-Used Boots; N.I.-New Insoles; U.I.-Used Insoles)					
		A N.B.-N.I.	B N.B.-N.I.	A U.B.-N.I.	B N.B.-U.I.	A U.B.-U.I.	B[a] U.B.-U.I.
1. Have your boots or insoles caused any discomfort	Yes	14	13	6	8	3	2
	No	1	2	9	7	12	12
2. What part of foot was uncomfortable	Sole:						
	Ball	9	7	3	3	2	1
	Heel	3	2	0	1	0	0
	Toes	2	2	4	2	1	0
	Top of foot	2	3	0	3	0	0
	Whole foot	0	1	0	0	0	1
3. To what degree were your feet uncomfortable	Slightly	1	4	1	3	2	1
	Moderately	6	4	5	5	1	1
	Extremely	7	5	0	0	0	0
4. In what way were your feet uncomfortable	Hot	13	8	5	2	2	1
	Felt compressed by tightness of boot	4	7	1	2	1	0
	Boots rubbed	0	1	0	4	0	0
5. What seemed to cause discomfort	Insole	5	6	5	3	3	1
	Seams	0	0	0	3	0	0
	Other	1	2	0	0	0	0
	No answer	8	5	1	2		1

[a] One participant withdrawn prior to test completion.

2.5.2 METHOD

Observations were made of all performances of all activities to detect any difficulty in the accomplishing of test activities. Test participants were interviewed after each cycle of use of given combinations of new and used boots and insoles regarding difficulty in performance of their activities.

The feet of each test participant were examined by an enlisted medical specialist prior to and periodically during test wear for any evidence of unusual or excessive foot damage resulting from the use of the test items.

Each boot was inspected daily for any evidence of wear or detrimental effects caused by the use of the test insoles.

2.5.3 RESULTS

The test supervisory personnel observed no difficulty in the performance of the test activities at any time during the test. In only 10 instances did the participants report difficulties. Seven men, 5 after the first cycle and 1 each after the second and third cycles, reported slight difficulty in ascending and descending slopes due to slight shifting of the foot on the saran surface of the insoles. Two men, 1 after each of the first two cycles, stated they had difficulty in completing the operations due to excessive heating of the sole of the foot. The other participant reported difficulty in completing the jumps on the Footwear Course due to the lack of foot support provided by the tropical boot.

Foot examinations made periodically during the test revealed no unusual or excessive foot damage resulting from the use of the test items.

Inspections of the boots revealed no signs of wear or other detrimental effects on the boots worn in the test.

2.5.4 ANALYSIS

Not applicable.

2.6. SAFETY

2.6.1 OBJECTIVE

To determine if safety hazards exist in the use of the experimental insoles.

2.6.2 METHOD

Constant observation of the test participants was made to determine any safety hazard created by the use of the test items. Test participants were questioned concerning the safety in the use of the test insoles and boots. Examinations were made of the feet of the participants for evidence of foot damage.

2.6.3 RESULTS

There were no instances where data were obtained, either through observations, interrogations, or examinations, to indicate that any combination of new and used boots and insoles was unsafe for use by the test personnel.

2.6.4 ANALYSIS

Not applicable.

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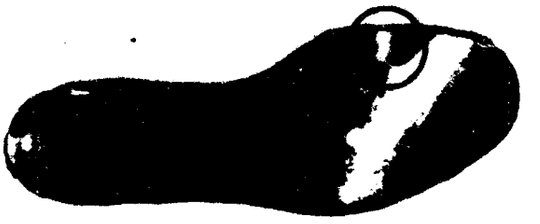
SECTION 3 - APPENDICES

Appendix I - Photographs

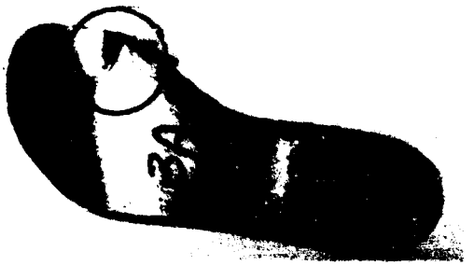
Appendix II - Deficiencies and Shortcomings

TYPICAL FAILURES IN SPIKE RESISTANT INSOLES

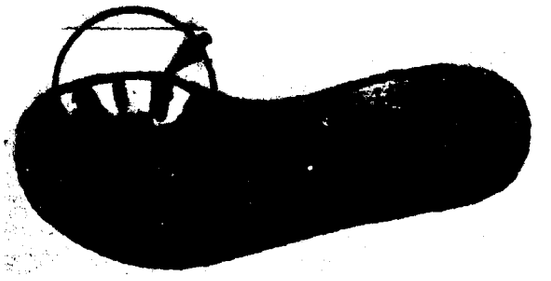
Curling and Deformation



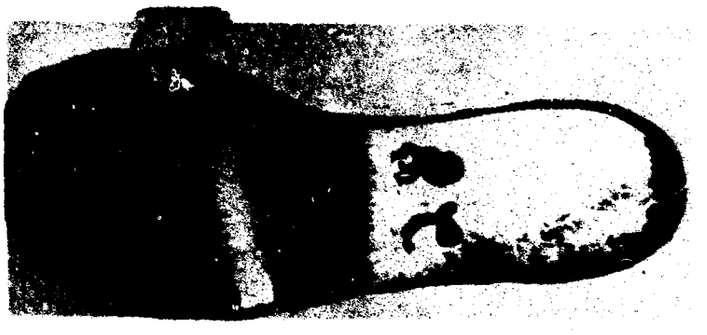
Buckling at Edge and Small Interior Cracking



Buckling at Edge and Smooth Crack Inward from Edge



Multiple Buckling and Cracking



Buckling and Jagged Cracking from Edge

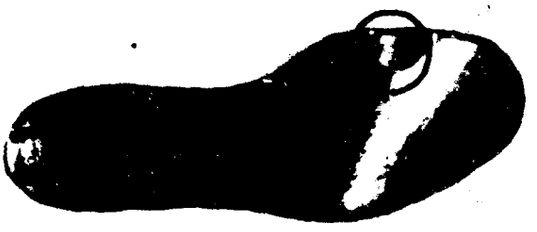
US ARMY
GETA
FORT LEE, VA.

TECOM 8-5-6010-01
36, 45, 43
NEGATIVE 40.41

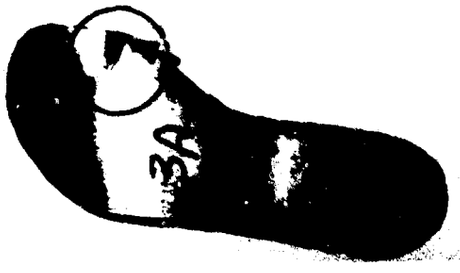
APPENDIX I

TYPICAL FAILURES IN SPIKE RESISTANT INSOLES

Curling and Deformation

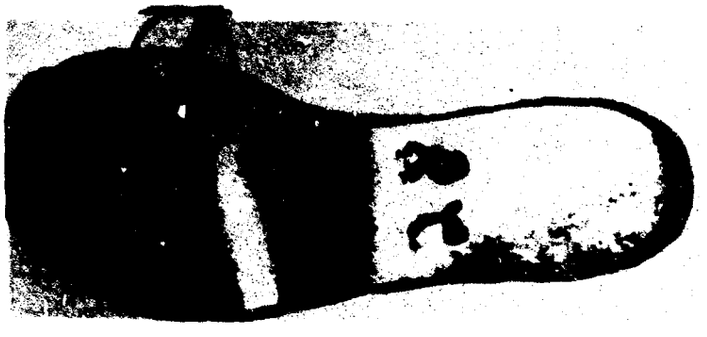


Buckling at Edge and Small Interior Cracking



Buckling at Edge and Smooth Crack Inward from Edge

Multiple Buckling and Cracking



Buckling and Jagged Cracking from Edge

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FORT LEE, VA.

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36, 45, 43
NEGATIVE 30, 31

APPENDIX 1

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APPENDIX II

DEFICIENCIES AND SHORTCOMINGS

1. DEFICIENCIES

DEFICIENCIES	SUGGESTED CORRECTIVE ACTION	REMARKS
Lack of retention of shape.	Redesign the insole to more closely conform to foot contours.	Curling and wrinkling are prevalent in test sample and occur after only slight use.
Lack of durability, especially resistance to cracking.	Redesign insole to fit curvature of foot and prevent wrinkling or buckling. Use metal more adaptable to flexing and resistant to cracking.	Cracking is predominantly at the inner ball area and results from frequent flexing.

2. SHORTCOMINGS

SHORTCOMINGS	SUGGESTED CORRECTIVE ACTION	REMARKS
Does not permit comfortable wear of the insole and foot combination.	Redesign insole to prevent excessive wrinkling. Use some layers of material to resist transfer of heat to bottom of foot.	The discomfort due to excessive heating of foot is the primary objection to the use of the insole.

AD Accession No.

U.S. Army General Equipment Test Activity, Fort Lee, Virginia

FINAL REPORT OF ENGINEERING TEST OF SPIKE RESISTANT INSOLE, by Edwin W. Mangum, August 1966. 28p. -tables, -illus., 2 Appendices p17-21. (TECOM Proj. No. 9-3-4010-01) Unclassified Report

This engineering test of an experimental spike resistant insole was conducted by the General Equipment Test Activity which was responsible for test plan preparation, test execution, and test reporting.

The test was conducted at Fort Lee, Virginia, during the period April - June 1966. The purpose of the test was to determine the technical performance and safety characteristics of the spike resistant insole worn in the standard tropical boot when subjected to accelerated usage.

It was found that a minimum force of 266 pounds was required at point of contact to pierce the combined outsole of the tropical combat boot and the experimental insole. The insoles are unsatisfactory from a durability standpoint, being highly susceptible to deformation and cracking. The insoles produce foot discomfort due to excessive heating of the soles of the feet. The insoles are satisfactory from a safety standpoint.

UNCLASSIFIED

I. Boots
2. Spike Resistant Insole
I. Mangum, Edwin W.
II. Title
III. TECOM Project No. 9-3-4010-01

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2. Spike Resistant Insole
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III. TECOM Project No. 9-3-4010-01

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